COLONY FORMATION OF A LIMPET, ACMAEA DORSUOSA GOULD, AND VARIATION OF LEVEL OF THE COLONY.

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COLONY FORMATION OF A LIMPET, *ACMAEA DORSUOSA* GOULD, AND VARIATION OF LEVEL OF THE COLONY.*

By

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(With 2 figures)

INTRODUCTION

A limpet, *Acmaea dorsuosa* GOULD, forms a colony on the rock over the high water marks in spring and in summer and shows homing behavior (Abe, 1931). But since the middle of September, the limpet shows dispersion from the colony, and migrates upward, but since the time of snow fall, it migrates downward and continues the life in winter. But in the next spring, the colony of the limpet is formed newly with new members added, though one part of them returns exactly to their original home of the former year. (Abe, 1933)

I have found that the levels of colonies are somewhat changed in 1952 to 1954 compared with the positions of colonies formed in 1931 and 1932. And I have examined the reason of variation of level of colony, and therefore I wish to explain the results of my observations. The present observations have been made at the Asamushi Marine Biological Station since 1952 to 1954.

Before going further, I wish to express my sincere thanks to Prof. Dr. Shinkishi Hatai for his kind guidance on all my studies done since 1931 to the present time.

I GEOGRAPHICAL NATURE OF POSITIONS OF THE OBSERVATION

I have examined all the colonies formed on Hadakajima, a little island situated on the western seashore of the Biological Station. Hadakajima means "Naked Is land" and its topography is shown in Fig. 1.

As is shown in Fig. 1, Hadakajima is of somewhat square form, and colonies of the limpet are formed mainly on the rocky shore facing northward, namely on the shore from St. 1 to St. 3 in Fig. 1, and no colony is seen on the other shore of the island. And there stands a massive rock of about 32 metres in height in the

* Dedicated to Professor Emeritus Dr. Shinkishi Hatai, the founder of the Marine Biological Station of Asamushi.

middle part of the island.

II VARIATION OF NUMBER OF INDIVIDUALS AND NUMBER OF COLONIES

Colonies formed on the rocky shore of Hadakajima were photographed in 1932, and their positions in 1932 can be compared exactly with the positions of colonies at the present time. The number of colonies and individuals in 1932 was compared with that at the present time, and the results are shown in Table 1.

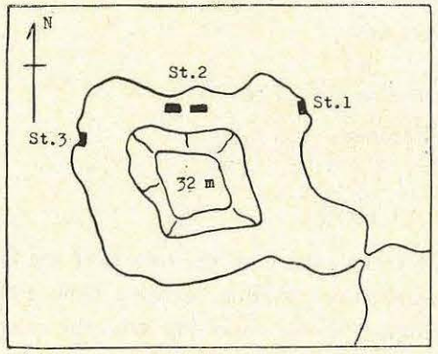

Fig. 1 Topography of Hadakajima.

As is shown in Table 1, the number of colonies has increased by about 2.8 to 3 times during the period from 1932 to 1954, while the number of individuals increased only by about 14 to 18% during these 21 to 22 years.

Table 1

Comparison of the numbers of colonies and individuals of the limpet, *Acmaea dorsuosa* GOULD.

Year	Relative positions of the colonies					
1932	(21)	(102)	(26)	(0)	(15)	(19)
1953	(19) (17)	(4) (14) (10) (9) (67)	(26) (14)	(26)	(24) (6)	(16) (7)
1954	(19) (16)	(3) (4) (9) (66)	(22) (12)	(34) (4)	(22) (12)	(16) (31)

Year	Relative positions of the colonies	No. of colonies	No. of individuals
1932	(170)	6	353
1953	(22) (94) (28)	17	402
1954	(18) (96) (20) (11)	18	419

III VARIATION OF LEVELS OF THE COLONIES

Colony of the limpet is formed just above the high water marks as already stated. (Abe, 1931, '33) But the levels of colonies formed in the years 1953 and 1954 are different from that formed about 20 years before, and degrees of variation of levels of the colonies is also different according to stations in Fig. 1. And the levels of colonies in each station are shown in Table 3.

In Table 2, -6 cm shows that the colony is formed 6 cm lower than the standard level, namely the upper margin of the colony formed in 1932, and +35 cm

Table 2

Compariosn of levels of colonies formed in 1953 and 1954 to the levels of colonies formed in 1932.

Station No.	Standard level in 1932	levels of colonies in 1953	levels of colonies in 1954
1	0	−6 cm, −9 cm	−7.2 cm
2	0	0 cm, −3.9 cm	0 cm, 0 cm
3	0	0 cm, +33 cm, +43 cm	0 cm, +33 cm, +35 cm, +43 cm

shows that the colony is formed 35 cm higher than the colony in 1932, and so forth.

Therefore it is clear that the level of colony was lowered about 6 to 9 cm in St. 1, but remarkable change was not seen in St. 2. But new colonies were formed at the levels of 33 to 43 cm above the former level in St. 3. Moreover, I have compared the level of colonies of the limpet formed in 1954 to the level of *Myitlus crassitesta* LISCHKE, though the latter species shows the remarkable increase of numbers and its distinct zone is shown in Fig. 2.

Fig. 2 A colony of the limpet, *Acmaea dorsuosa* GOULD (a) and the *Mytilus crassitesta* zone (m). (photographed in August, 1954).

The distance from the lower level of the colony of the limpet to the upper level of the *Mytilus* zone is measured in Stations 1, 2 and 3 and the results are shown in Table 3.

In Table 3, it is clearly seen that the distance of colonies from the *Mytilus* zone is different according to Station, namely the distance is largest in St. 3 and

Table 3

Distance of the lower level of colony of the limpet from the upper level of the *Mytilus* zone.

Station No.	Minimum distance	Maximum distance	Difference
1	21 cm	21 cm	0
2	26 cm	46 cm	20 cm
3	41 cm	84 cm	43 cm

smallest in St. 1. Moreover, frequency of distance between them is also different according to Station, and it shows the largest value in St. 3.

IV GENERAL CONSIDERATION

According to the results mentioned above, it can be said that the levels of colonies of the limpet in 1954 are different from that in 1932. And the results became to the same state that tide level is retired downward in the east side of the island, namely in St. 1, but on the contrary, the tide level is uplifted in the west side of the island, namely in St. 3.

Then, why such a difference occurred? Here I can assumed that the rock of the island, Hadakajima, may be inclined in these 20 years, namely, the east side of the siland is uplifted and the west side of the island sank. But another reason is also assumed that direction and velocity of wind are changed, and consequently physiological tide level is changed, and therefore the colonies of the limpet are formed on the dfferent levels adapted to the changes of the tide level.

a) *Change of direction and velocity of wind.*

I have examined the velocity and direction of wind in every months in 1932, '33 and 1935 based upon the data taken by the Marine Biological Station, and compared with the data in 1952 and 1953, and found that both direction and velocity of wind are distinctly different from each other. Especially it seems to me that the direction and the velocity of wind in the months of March and April are most related with the formation of colony of the limpet, though the limpet begins to form a new colony at the end of March and completes by the middle of April.

The data of direction and velocity of wind in 1935 and 1952 are shown in Table 4.

In Table 4, it is clear that direction of wind is distinctly different between both years, namely, S W wind is the strongest in 1935, but West wind is the strongest in 1952.

Now comparing the adta in Table 4 and the directions of the rocky shores in Fig. 1, it is easy to consider that waves sprush more vigorously in 1952 than in 1935 in St. 3. And the East wind is stronger in 1952 than in 1935, but the North-

Table 4

Comparison of velocity and direction of wind in the months of March and April.

Direction / Year	E	NE	N	NW	W	SW	S	SE
1935	34	4	3	155	198	227	5	0
1952	67	0	4	19	304	50	0	0

Numbers in the table shows the total velocity of wind in metres which is measured three time in a day.

west wind is distinctly weakened in 1952 than in 1935. Therefore, it may be considered that waves may sprush more gently in 1952 than in 1935.

Therefore it is considered that physiological tide level is more uplifted in 1952 in St. 3, but on the contraly, physiological tide level more descended in 1952 than in 1935 in St. 1. Consequently, the level of colony of the limpet is influenced by the variation of the physiological tide level and the results became as are shown in Tables 3 and 4.

b) *Change of zonation of inhabitants.*

As for inhabitants in the neighbourhood of the colony of the limpet, zonation of inhabitants in St. 1 was shown in Fig. 4 of the paper by Abe (1933), and zonation of inhabitants in St. 3 was shown in Table 2 in the paper by Abe (1940). In St. 1, number of *Mytilus crassitesta* increase and show *Mytilus* zone as is seen in Fig. 2 in the present paper, but on the contraly, *Septifer virgatus* (WIEGMANN) became very rare.

In St. 3, *Mytilus* zone is already seen as is shown in Table 2 (Abe, 1940), but number of individuals of *Mytilus* has increased moreover at the present time. In St. 2, inhabitants in 1931 are seen in Fig. 3 of the paper by Abe (1931) and also shown in Fig. 3 in Plate XII (Abe, 1931), and the *Mytilus* was seen only here and there; but *Mytilus* show excellent zone at the present time.

As mentioned above, the most prominent change of inhabitants is seen only in *Mytilus crassitesta*. As for other animals, *Thais* (*Mancinella*) *tumulosa clavigera* (KUSTER) and *Morula granulata* (DUCLOS) come to the level of the *Mytilus* for feeding on *Mytilus*, but they do not climb up to the level of the limpet, *Acmaea dorsuosa* GOULD. Therefore, it seems to me that such a change of zonation of the *Mytilus* do not show exact influence to the formation of colony of the limpet.

But I have observed that increase of number of barnacles, *Chthamalus challengeri* HOEK prevent the formation of colony of the limpet, and positions of colonies are gradually transferred, though such an example is seen in the neighbourhood of St. 1.

SUMMARY

Number of individuals and number of colonies of the limpet, *Acmaea dorsuosa* GOULD, in 1932 was compared with those in 1953 and 1954, and their changes during these 20 years were examined.

1. Number of colonies was increased and shows about 2.8 to 3 times over in 1954 than in 1932, while the number of individuals is increased only by about 14 to 18% during these 20 years.

2. Levels of the colonies of the limpet was lowered about 6 to 9 cms in St. 1, namely on the rocks facing eastweard, but remarkable change is not seen in St. 2, namely on the rocks facing northward. But new colonies are formed on the level of 33 to 43 cm above the former levels in St. 3, namely on the rocks facing westward.

3. Distance of colonies from the upper level of *Mytilus crassitesta* zone is different according to Stations, namely the distance is the largest, showing from 41 cm to 84 cm, in St. 3 and it is smallest, showing 21 cm, in St. 1, though it shows from 26 cm to 46 cm in St. 2.

4. Direction of wind is distictly different during these 20 years, namely S-W wind is the strongest one in 1935, but West wind is the strongest in 1952.

5. According to the veriation of velocity and direction of wind, physiological tide level is more uplifted in 1952 than in 1932 in St. 3, namely on the rock facing westward, but on the contrary, physiological tide level more descended in 1952 than in 1935 in St. 1, namely on the rock facing eastward. Consequently, the level of colony of the limpet is influenced by the variation of the physiological tide level.

6. In the neighbourhood of the Marine Biological Station, number of individuals of *Mytilus crassitesta* increased more prominently in 1952 than in 1932, but such a change of zonation of *Mytilus* do not show exact influence on the colony formation of the limpet. But increase of number of barnacles prevent the colony formation of the limpet.

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A PRELIMINARY REPORT ON THE POISONOUS EFFECT OF THE *TOXOPNEUSTES* TOXIN UPON THE HEART OF OYSTER

By

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(With 11 Text-figures)

Most abalone-fishing divers have an intensive fear that the trumpet sea-urchin, *Toxopneustes pileolus* (LAMARCK), is poisonous and it is very dangerous to come in contact with their bodies. Nevertheless, no reports have been found, till to-day, concerning the biological research for so-called "*Toxopneustes* toxin", so far as we could know.

In the case of *Toxopneustes pileolus*, two kinds of modified pedicellariae, peculiar to this species, can be observed besides the ordinary pedicellariae, common in sea-urchins (Fig. 1). We will call the one "trumpet pedicellaria", and the other "giant pedicellaria". The body surface of this species, when living, is covered by numerous trumpet pedicellariae, each of which spreading out among numerous spines and opening fully its trumpet-like tip with three fine hooks. A few giant pedicellariae of three-lobed large tip with similar hooks are mingled here and there among these trumpet ones. The white mucous fluid is ejaculated through these fine hooks, if the fully opened tips of these pedicellariae are stimulated by a sudden contact to close themselves vigorously. The vigorous closing reaction is exceedingly remarkable in the response of giant pedicellariae. Such a mucous fluid, from the giant and trumpet pedicellariae, is supposed to contain the above-mentioned toxic substance of this species or "*Toxopneustes* toxin".

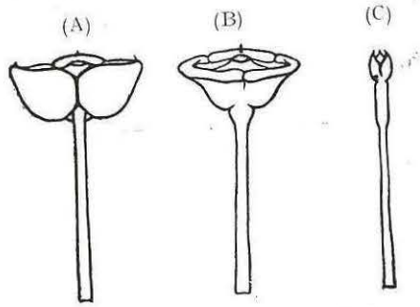

Fig. 1. Schematic representations, illustrating three kinds of pedicellariae of *Toxopneustes pileolus*. × 5.
(A) giant pedicellaria, (B) trumpet pedicellaria, (C) ordinary pedicellaria.